Canada. Board of examiners
for dominion land surveyors
Rules and regulations.

1910 - 1912

RULES AND REGULATIONS

OF THE

BOARD OF EXAMINERS

FOR

DOMINION LAND SURVEYORS

AND

PROGRAMME OF THE SUBJECTS

OF THE

VARIOUS EXAMINATIONS

OTTAWA
GOVERNMENT PRINTING BUREAU
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RULES AND REGULATIONS

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BOARD OF EXAMINERS FOR DOMINION LAND SURVEYORS.

Regular annual examinations.

1. (*a*) The regular annual examination for admission as articled pupil, for Commission as Dominion Land Surveyor, and for Certificate as Dominion Topographical Surveyor begins on the Tuesday following the second Monday in February and continues day by day until completed.

It is held at Ottawa and at such other place or places as the Minister may direct.

Special Examinations.

(*b*) Examinations held at other times by the direction of the Minister (D.L.S. Act, s. 12) are known as Special Examinations.

Full Preliminary Examination.

2. (*a*) The examination for admission as articled pupil is known as the Full Preliminary Examination. The particulars are given in Schedule A.

(*b*) Candidates who come under the provisions of section 22 of the Dominion Lands Surveys Act, and candidates who hold university or college degrees in arts or science, and who in obtaining such degrees have followed a regular course of study in the mathematical subjects prescribed for the Full Preliminary Examination during the regular university or college sessions for at least two years, may at their option, take an examination consisting of two papers comprising the subjects of the Full Preliminary Examination. This examination is known as the Limited Preliminary Examination. The particulars are given in Schedule B.

Limited Preliminary Examination.

Final Examination.

(*c*) The examination for Commission as Dominion Land Surveyor is known as the Final Examination for Dominion Land Surveyor. The particulars are given in Schedule C.

D. T. S. Examination.

(*d*) The examination for Certificate as Dominion Topographical Surveyor is known as the Examination for Dominion Topographical Surveyor. The particulars are given in Schedule E.

Final Examination for holders of provincial certificates.

3. Surveyors holding provincial certificates and applying for examination under section 21 of the Dominion Lands Surveys Act shall submit such certificates to the Board along with

their applications, and such further evidence as to their service under articles as the Board may require. The term of service, if insufficient, must be completed before examination.

The subjects of examination for surveyors holding provincial certificates are mentioned in Schedule D of these Rules.

4. The clause of the Dominion Lands Act under which surveyors from His Majesty's dominions, other than Canada, could come up for final examination after one year's service as pupil with a Dominion Land Surveyor, has been abrogated by the Dominion Lands Surveys Act, 1908.

Meeting of Board prior to examinations.

5. The Board of Examiners will meet prior to each examination to consider the qualifications of those candidates whose applications have been received, and will continue to sit until the examination and the business of the Board are finished.

Time-tables for examinations.

6. For examinations held simultaneously at various places, the examination questions are the same for the respective schedules, and according to time-tables supplied by the Board of Examiners.

Examination papers.

7. Before each examination, the question papers are prepared by the Board of Examiners and the necessary copies forwarded to the presiding examiners at the different places.

Hours of examinations.

8. The examination sittings shall begin at 9.00 a.m. and continue until 12.00 m.; they shall begin again at 1.30 p.m. and continue until 4.30 p.m. daily, except Sundays, until the completion of the examination.

Candidates to present themselves punctually.

9. Candidates are to present themselves punctually at the hours appointed for the commencement of the examinations, and no candidate will be allowed to enter the examination room later than fifteen minutes after that time; nor will any candidate be allowed to leave the room during a sitting—save in cases of extreme necessity; but as soon as he has finished his papers, he may hand them to the examiner and retire until the next sitting.

Candidates not to obtain assistance.

10. Candidates must not bring into the examination room any books, papers or notes, except such as are necessary in the solution of problems, and have been submitted to the presiding examiner.

Should it appear to the presiding examiner during an examination, or to the members of the Board during the reading of the answers, that any candidate has broken this rule, or has obtained assistance from any other candidate, the papers of

such candidate obtaining assistance shall be cancelled. The candidate from whom such assistance was obtained shall be held to be equally guilty, and shall be dealt with accordingly.

11. Silence shall be observed by the candidates in the examination room while the examination is in progress. Silence in examination room.

12. Before the beginning of the examination, the Secretary of the Board, or the presiding examiner, shall read over and make clear to the candidates the clauses of these Rules relating to the conduct of examinations, laying special stress on those parts referring to the obtaining of assistance and to the method of signing and arranging the answer papers. Rules to be read to candidates.

13. The stationery required for examinations is supplied by the Board. The answers shall be written in ink (except necessary diagrams, which may be in pencil), and on one side only of the paper. Stationery supplied by Board.

14. Each sheet of paper shall have at the top the name of the subject, the number of the question, and the name of the candidate. A margin shall be left along the left hand side of the sheet. Information on each sheet.

15. Not more than one answer shall be written on the same sheet of paper.

16. The candidate shall not write on one line more than one step in geometrical or algebraic work. A single step may cover several lines, but two or more should in no instance be put on the same line. They should be put thus:— Method of arranging answers.

Because	A=B
And	B=C
Therefore	A=C

In additions or subtractions, numbers shall be written under each other.

17. Before handing in his answer papers, the candidate shall arrange the sheets in the order of the questions (not in the order in which he may have answered the questions), shall page them consecutively, and fasten them together at the left hand upper corner. The sheets are not to be folded. Candidate to arrange sheets.

18. No person other than the members of the Board, the presiding examiner, the Secretary and the candidates shall be admitted into the examination room while the candidates are writing. Only certain persons admitted to examination room.

Percentage required.

19. No candidate will be considered to have passed in any examination unless he has obtained at least 50 per cent of the maximum number of marks in each subject of such examination, with the exception of the Manual of Survey for which he must have obtained at least 80 per cent of the maximum.

Supplemental Examination.

20. (*a*) A candidate who has failed in not more than half of the number of subjects may present himself subsequently for examination in such subjects, but this rule does not apply to the Limited Preliminary Examination.

Second Supplemental Examination.

(*b*) A candidate at such Supplemental Examination who fails in more than two subjects, is not allowed a further Supplemental Examination. Should he again present himself he must take the whole examination. Those who fail in one or in two subjects are allowed a Second Supplemental Examination.

(*c*) A candidate at such Second Supplemental Examination who fails in any subject is not allowed any further Supplemental Examination. Should he again present himself, he must take the whole examination.

Candidates for D. T. S. Examination.

(*d*) Candidates for the examination for Dominion Topographical Surveyor may take it in two parts as indicated in Schedule E, provided they give notice of their intention to the Secretary at least one month before the meeting. They will be allowed Supplemental Examinations in each part as provided in the rules.

Marks supplied on request.

21. The Secretary is authorized to furnish to any candidate who applies for it, a list of his marks in the different subjects, but not the marks for the individual questions.

Term of service not complete.

22. The Board will not admit to the Final Examination for Dominion Land Surveyor any pupil whose term of service at the opening of the examination is not completed, or within three weeks of completion.

In the latter case if the candidate is successful in passing the examination, the Commission as Dominion Land Surveyor will not issue until the completion of his term of service.

Candidates to bring transit theodolite.

23. Each candidate for the Final Examination shall bring with him a transit theodolite, reading at least to one minute, and he shall also submit a plan on drawing paper and field notes of a survey, all made by himself, which shall be filed with the papers in Practical Surveying.

Tables supplied.

24. Chambers's Mathematical Tables are to be used at all examinations, and copies will be supplied to those candidates who do not bring their own.

Astronomical Almanacs supplied.

25. Astronomical Almanacs are supplied by the Board to candidates at the Final Examination.

26. The apparent or presumed results of the examination are not communicated to any person until the same have been officially announced.

Duties of presiding examiner.

27. Special examiners appointed under section 12 of the Dominion Lands Surveys Act shall, after the completion of the examination under their supervision, return to the Secretary for the consideration of the Board the written answers of the candidates. They shall further examine the candidates at the Final Examination in the use of instruments, in practical surveying, in the keeping and plotting of field notes, and in the taking of astronomical observations; and shall report to the Board on all these matters.

At Special Examinations fees of presiding examiner paid by candidates.

28. Candidates who desire Special Examinations are required to pay to the credit of the Receiver General the fees of the examiner, and also his travelling and living expenses when he holds the examination at a place other than that in which he usually resides.

The fees of the examiner are five dollars per diem.

The aforesaid amounts, as well as the fees provided by the Act, must be paid before the examination takes place.

When several candidates present themselves at the same time, the fees and the expenses of the examiner are charged to them in proper proportions.

Blank forms supplied by Secretary.

29. Blank forms for articles of apprenticeship, transfer of articles, oaths of allegiance and of office, and bonds, are supplied by the Secretary to those entitled to receive them.

Correspondence addressed to Secretary.

30. All correspondence intended for the Board must be addressed: "Secretary, Board of Examiners for Dominion Land Surveyors, Department of the Interior, Ottawa."

Fees should be remitted by registered letter, or by Post Office Money Order, or Express Money Order payable to the order of the Secretary.

Articles of apprenticeship and documents of value must be sent by registered mail.

31. Articles of apprenticeship, bonds, etc., improperly executed are returned to the sender if the imperfection is noticed; and it rests with him to have the necessary corrections made. The Board assumes no responsibility in the matter.

SCHEDULE A.

Full Preliminary Examination.

	Marks.
Penmanship	50
Orthography	200
Arithmetic and Logarithms	100
Algebra	100
Plane Geometry	200
Plane Trigonometry	100
Spherical Trigonometry	100
Mensuration of Superficies	100

For each error in orthography in the paper entitled "Penmanship and Orthography" a deduction of 10 marks is made.

Time required, four days.

SCHEDULE B.

Limited Preliminary Examination.

	Marks.
Penmanship	50
Orthography	200
The Mathematical Subjects	700

In order to pass, a candidate must make 50% in each of the subjects, Penmanship and Orthography, and 50% in the Mathematical Subjects. For each error in the paper entitled "Penmanship and Orthography," a deduction of 10 marks is made.

Time required, one day.

SCHEDULE C.

Final Examination for Dominion Land Surveyor under Section 23 of the Dominion Lands Surveys Act.

	Marks.
Plane Geometry	150
Solid Geometry	75
Spherical Trigonometry	125
Measurement of Areas and Subdivision of Land.	200
Descriptions for Deeds	100
Astronomy (including observing)	250
Manual of Surveys and Dominion Lands Surveys Act	200
Practical Surveying	200

Time required, six days.

SCHEDULE D.

Final Examination for Dominion Land Surveyor under section 21 of the Dominion Lands Surveys Act.

	Marks.
Penmanship	50
Orthography	200
Algebra	100
Plane Geometry	150
Solid Geometry	75
Spherical Trigonometry	125
Measurement of Areas and Subdivision of Land	200
Descriptions for Deeds	100
Astronomy (including observing)	250
Manual of Survey and Dominion Lands Surveys Act	200
Practical Surveying	200

For each error in orthography in the paper entitled "Penmanship and Orthography," a deduction of 10 marks is made.

Time required, seven days.

SCHEDULE E.

Examination for Dominion Topographical Surveyor.

Part I.

	Marks.
Algebra	50
Plane and Spherical Trigonometry	75
Analytical Geometry	100
Descriptive Geometry and Projections	75
Differential and Integral Calculus	100
Probability and Least Squares	150

Time required, three days.

Part II.

	Marks.
Geodesy	125
Astronomy	250
System of Dominion Land Surveys; topographical and exploratory surveys	150
Theory, Construction and Adjustment of Instruments	150
Gravity and Terrestrial Magnetism	100
Meteorology, Geology and Mineralogy	75

Time required, three and one-half days.

PROGRAMME OF THE SUBJECTS

OF THE

VARIOUS EXAMINATIONS BEFORE THE BOARD OF EXAMINERS FOR DOMINION LAND SURVEYORS.

FULL PRELIMINARY AND LIMITED PRELIMINARY EXAMINATIONS.

Penmanship and Orthography.

A paper or dictation of about 280 words will be given.
More than ten errors will cause the rejection of the candidate.
Candidates may write either in English or in French.

Arithmetic and Logarithms.

Greatest common measure and least common multiple.
Vulgar and decimal fractions.
Measures of length, capacity, area, weight, time and currency.
Square and cube root.
Interest and discount.
Use of Logarithmic tables.

Algebra.

Highest common divisor.
Lowest common multiple.
Factoring.
Simplification of expressions.
Equations of the first degree of one or more unknown quantities.
Quadratic equations and equations solved like quadratics.
Problems depending for their solution upon algebraic equations.

Text book:—
HALL AND KNIGHT—Elementary Algebra.

Plane Geometry.

Euclid's Elements—first four books, the sixth book and the definitions of the fifth; or,
Legendre's Géométrie—first four books.
Deductions from the propositions.
Questions as to the propositions, their practical applications, and the arithmetical or algebraic propositions corresponding to those propositions which relate to lengths of lines or areas

Text books:—
Hall and Stevens—Euclid's Elements, Books I. to VI., and XI.; or,
Legendre—Eléments de Géométrie, or,
Taylor—Euclid's Elements of Geometry.

Plane Trigonometry.

Measures of angles and arcs; the trigonometric ratios; fundamental formulæ.
Signs of trigonometric ratios.
Solution of plane triangles: right angled and oblique.
Problems depending upon the foregoing.

Text book:—
Hall and Knight—Elementary Trigonometry.

Spherical Trigonometry.

Fundamental formulæ; Napier's analogies; circular parts.
Solution of spherical triangles: right angled, quadrantal and oblique.
Problems depending for their solution upon the foregoing.

Text book:—
Todhunter and Leathem—Spherical Trigonometry.

Mensuration of Superficies.

Areas of rectilinear figures, and of figures bounded by arcs of circles.
Areas of surfaces of right circular cones, circular cylinders, spheres, prisms, pyramids and parallelopipeda.

Text book:—
Knott and Mackay—Practical Mathematics.

TEXT BOOKS RECOMMENDED.

HALL AND KNIGHT—Elementary Algebra, *Macmillan & Co.*

HALL AND KNIGHT—Elementary Trigonometry, *Macmillan & Co.*

HALL AND STEVENS—Euclid's Elements, Books I. to VI., and XI., *Macmillan & Co.*

KNOTT AND MACKAY—Practical Mathematics, *Van Nostrand.*

LEGENDRE—Eléments de Géométrie, *Firmin Didot.*

TAYLOR—Euclid's Elements of Geometry, *Macmillan & Co.*

TODHUNTER AND LEATHEM—Spherical Trigonometry, *Macmillan & Co.*

FINAL EXAMINATION FOR DOMINION LAND SURVEYOR.

Penmanship and Orthography.

The candidates write on the same paper as those taking the Preliminary Examination. See page 10.

Algebra.

The limits of the work are the same as for the Preliminary Examination. See page 10.

Plane Geometry and Mensuration.

First four and sixth books of Euclid's Elements, and the definitions of the fifth; or first four books of Legendre's Géométrie.

Proofs of the propositions and of deduced propositions.

Questions on the propositions.

Mensuration of plane figures bounded by straight lines or circular arcs, and of the surfaces of solids having either plane or spherical, conical or cylindrical boundaries.

Application of Geometry to plotting, and to surveying without angular instruments.

Text books:—

HALL AND STEVENS—Euclid's Elements, Books I. to VI., and XI.

KNOTT AND MACKAY—Practical Mathematics.

LEGENDRE—Eléments de Géométrie.

Solid Geometry and Spherical Trigonometry.

Legendre's Géométrie, or the eleventh book of Euclid's Elements. Definitions, proofs and applications of the propositions, and deductions therefrom.

The volume of solid bodies bounded by plane, spherical, conical, or cylindrical surfaces.

Great and small circles of the sphere—Angles between great circles.

General propositions relating to the angles and sides of spherical triangles—The polar triangle.

Proofs of the fundamental formulæ connecting the sides and angles of a spherical triangle.

Deduction of the formulæ for the solution of right angled, quadrantal, and oblique angled triangles.

The conditions of ambiguity of solution of spherical triangles.

Solution of given triangles and of problems depending for their solution upon spherical trigonometry.

Spherical excess.

Text books:—

LEGENDRE—Eléments de Géométrie, or,

TAYLOR—Euclid's Elements of Geometry, or,

TODHUNTER—Elements of Euclid.

TODHUNTER AND LEATHEM—Spherical Trigonometry.

Astronomy.

The celestial sphere—Spherical coördinates, altitude and azimuth, declination and hour angle, declination and right ascension, celestial latitude and longitude.

Coördinates of the observer's position.

Application of Spherical Trigonometry to the transformations from one system to another. Solution of the astronomical triangle.

Time:—Sidereal and solar day; apparent and mean solar time; equation of time; astronomical and civil time; standard time; transformation of one kind of time into another.

The use of the Ephemeris or Nautical Almanac.

Simple interpolation, and interpolation by second differences.

Astronomical refraction; tables of refraction.

Correction to be applied to the observed altitude of the sun, moon, or a star.

Calculation of the latitude of a place from an observation of the meridian altitude of the sun or a star, and from an altitude of a star on the prime vertical.

Calculation of the local time and the azimuth from an observed altitude of the sun or a star.

Calculation of the direction of the meridian from an observation of a circumpolar star at its greatest elongation, or at any hour angle.

Candidates will be expected to take these observations for time, latitude and azimuth, with an instrument in the presence of the Board.

Text book:—
GREENE—Spherical and Practical Astronomy.

Measurement of Areas and Subdivision of Land.

Problems on the partition of land, the rectification of boundaries, and the measurement of areas.

Measurement of areas by means of latitudes and departures. Balancing the traverse. Supplying lost distances and bearings.

Text book:—
JOHNSON—Theory and Practice of Surveying.

Descriptions for Deeds, &c.

Descriptions by metes and bounds.

Descriptions by sections or legal subdivisions of the Dominion Lands System.

Descriptions by lots, or parts of lots.

Drawing up affidavits as to position of lost corners, &c.

Manual of Survey and Dominion Lands Surveys Act.

The Manual of Instructions for the Survey of Dominion Lands, Chapters I., II. and III.

Those parts of the Dominion Lands Surveys Act which relate to the re-establishment of lost corners and the division of regular and fractional sections, and to the other matters connected with the practice of surveying.

Practical Surveying.

Each candidate is expected, at some time previous to his examination, to make a survey of a piece of land having not less than five sides, and containing water, hills and other topography, and to furnish the Board at the time of his examination with his field notes of the same neatly copied and a neat plan in colours drawn by himself.

These notes and the plan will be retained by the Board.

He is further expected to bring with him to the examination a transit theodolite reading at least to minutes.

The Board will examine him as to the adjustments and use of the instruments, as to his manner of keeping rough field notes, and as to his plotting of the same.

TEXT BOOKS RECOMMENDED.

GREEN—Spherical and Practical Astronomy, *Ginn & Co.*

HALL AND STEVENS—Euclid's Elements, Books I. to VI., and XI., *Macmillan & Co.*

JOHNSON—Theory and Practice of Surveying, *Wiley & Sons.*

KNOTT AND MACKAY—Practical Mathematics, *Van Nostrand.*

LENGEDRE—Eléments de Géométrie, *Firmin Didot.*

TAYLOR—Euclid's Elements of Geometry, *Macmillan & Co.*

TODHUNTER—Elements of Euclid, *Macmillan & Co.*

TODHUNTER AND LEATHEM—Spherical Trigonometry, *Macmillan & Co.*

EXAMINATION FOR DOMINION TOPOGRAPHICAL SURVEYOR.

Algebra.

Scales of notation.
Surds and imaginary quantities.
Permutations and combinations.
Binomial theroem.
Exponential and logarithmic series.
Inequalities.
Undetermined coefficients.
Recurring series.
Summation of series.
Theory of numbers.
Determinants.
Problems.

Text book:—

HALL AND KNIGHT—Higher Algebra, Chapters 7, 8, 11, 13, 14, 17, 19, 22, 24, 29, 30 and 33.

Trigonometry—Plane and Spherical.

Solution of trigonometric equations.
Development in series of trigonometric functions.
Construction of natural and logarithmic trigonometric tables.
Addition and subtraction logarithms.
Approximate solution of spherical triangles in certain cases.
On small variations in the parts of a spherical triangle.
On the connection of formulæ in Plane and Spherical Trigonometry.
Polyhedrons.
The general spherical triangle.
Examples.

Text books:—
CHAUVENET—Plane and Spherical Trigonometry. Plane, Chapters 10, 13 and 15; Spherical, Chapters 3, 4 and 7.
SNOWBALL—Plane and Spherical Trigonometry, Appendices 2 and 3.
TODHUNTER AND LEATHEM—Spherical Trigonometry, Chapters 14, 15 and 16.

Coördinate Geometry:

Two Dimensions.

Coördinates.
The straight line.
Change of axes, anharmonic ratios or cross ratios, involution.
The circle.
The parabola.
The ellipse.
Polar equation of a conic.
General equation of the second degree.
Miscellaneous propositions.

Text book:—
SMITH—Conic Sections, Chapters I. to X. (inclusive).

Three Dimensions.

Coördinates.
The plane, the straight line, transformation of coördinates.
Surfaces of the second degree.
Conicoids referred to their axes.
Plane sections of conicoids.

Surfaces in general.
Curves.
Curvatures of surfaces.

Text book:—
SMITH—Solid Geometry, Chapters I., II., III., IV., V., X., XI. and XII.

Descriptive Geometry.

Orthographic projection. Points, lines and planes. Projection of curves, tangents and normals. Curved surfaces; tangent planes and intersection by planes. Problems.

Linear perspective. Perspectives of points, straight lines and curves. Line of apparent contour. Problems.

Isometric projection. Projection of points and lines. Problems.

Text book:—
CHURCH—Descriptive Geometry, Parts I., IV. and V.

Projections.

General equation of a projection. Development and perspective projections.

Developments with the pole as a centre and when the centre is not at the pole.

Perspective projections. Point of vision on the sphere, at infinity or anywhere outside the sphere.

Conical developments.

Formulæ for the construction of the various projections. Expressions for radial and transverse scales and for errors of representation. Determination of constants for minimum misrepresentation.

Text books:—
BREED AND HOSMER—Vol. II., Chapter X.
CHURCH—Descriptive Geometry, Part II.
CLARKE—Encyclopedia Britannica, Construction of maps.
CLOSE—Topographical Surveying, Chapter XI.

Differential Calculus.

First principles.
Differentiation and successive differentiation.

Taylor's, Maclaurin's, John Bernouilli's series, &c.
Evaluation of indeterminate forms.
Partial differential coefficients and differentiation of functions of two or more variables.
Maxima and minima.
Tangents and normals to curves.
Asymptotes, convexity and concavity, points of inflexion, envelopes.
Curvature.

Text book:—
WILLIAMSON—Differential Calculus, Chapters 1, 2, 3, 4, 5, 6, 9, 12, 13, 15, 16 and 17.

Integral Calculus.

Integration considered as the reverse of differentiation, and also as a method of summation.
Fundamental formulæ and methods.
Principal methods of reducing integrals to integrable forms; rational fractions; reduction.
Simpson's Rule; Weddle's Rule; Edward's Rule; the Surd Rule.
Determination of areas, lengths of curves, surfaces, volumes, moments of inertia, radius of gyration, centre of pressure, &c.
Elementary theory of differential equations.

Text book:—
LODGE—Integral Calculus.

Probability and Least Squares.

Probability and mean values.
General principles of the method of least squares, definitions and assumptions, deductions of the equation to the probability curve, the probability integral.
The arithmetic mean, probable error, mean square error, average error.
Rejection of observations.
Precision of observations.
Direct observations of a single quantity.
Indirect observations; normal equations; weights.
Conditioned observations.
Empirical formulæ.
Application of methods to practical cases.

Text books:—

HALL AND KNIGHT—Higher Algebra, Chapter XXXII.
MERRIMAN—Text Book on the Method of Least Squares.
WILLIAMSON—Integral Calculus, Chapter XII.

Geodesy.

Triangulation. Reconnoissance. Signals.
Base line measurement.
Trigonometric and precise levelling.
Figure of the earth.
Geodetic positions.
Determination of the dimensions of the ellipsoid.

Text books:—

BREED AND HOSMER—Vol. II., Chapters I. and III.
BURRARD—Instructions for Trigonometrical Branch, Part I.
CLOSE—Topographical Surveying, Chapters II. and III.
CRANDALL—Geodesy and Least Squares, Chapters I., II., IV.; V., VI., VII., VIII. and XI.
GORE—Geodesy, Chapters III., IV., VI., VII. and VIII.
HAYFORD—Triangulation along the 98th Meridian.
HAYFORD—Precise Levelling.
JOHNSON—Surveying, Chapter XIV.
MERRIMAN—Surveying and Geodesy, Chapters II., III., IV., VII., VIII., IX. and X.

Astronomy.

Different systems of spherical and rectangular coördinates.
Interpolation.
The Ephemeris or Nautical Almanac.
Reduction of star places from mean to apparent places.
Parallax; refraction; dip; semi-diameters.
Finding time—various methods; effect of small errors in data on deduced time.
Finding latitude—various methods; effect of small errors in data on deduced latitude.
Finding longitude—various methods; effect of small errors in data on deduced longitude.
Finding meridian line—various methods; effect of small errors in data on deduced azimuth.
The transit instrument—its use, including the registering micrometer.
The altitude and azimuth instrument—its use.
The zenith telescope—its use.

Text books,—

CHAUVENET—Spherical and Practical Astronomy, Vol. I., Chapters 1, 2, 4, 5, 6, 7, 9 and 11; Vol. II., Chapters 5, 7 and 8.

HAYFORD—Appendix No. 8, Report 1904, U. S. Coast and Geodetic Survey.

NEWCOMB—Compendium of Spherical Astronomy, Chapters 2, 9, 10 and 11.

System of Dominion Land Surveys; topographical and exploratory surveys.

Appendix to the Manual of Survey.

Construction and use of the Tables of the above appendix.

Problems connected with the System of Survey.

Measurement of distances by the doubly refracting prism micrometer; divided object-glass micrometer; stadia threads; movable thread micrometer; odometer; pedometer.

Determination of the bearings of a traverse with solar compass; magnetic compass; box sextant; or transit theodolite. What are the checks on the traverse?

Exploratory survey with pocket sextant, compass, micrometer, watch and aneroid; and its adjustment.

Topographic survey by aneroid; by "boiling-point" thermometer.

Latitude observations (different methods) as check on traverse.

Use of pocket chronometer for longitude—what errors may be expected.

Longitude by lunar distance; degree of accuracy.

Longitude by moon culminations with small transit; probable error of the resulting longitude.

Text books:—

Appendix to the Manual of Survey.

MIDDLETON AND CHADWICK—A Treatise on Surveying, Part II, Chapters XI., XII. and XIII.

Theory, Construction and Adjustment of Instruments.

Instruments.

Graduated circles. The vernier. Reading microscope. Micrometers. Levels.

Chronometers. Chronographs.

Sextant. Reflecting circle. Prismatic circle.

Theododite. Altazimuth. Astronomical transit. Zenith telescope.

Precise levelling instrument. Levelling rod.
Base measuring apparatus. Tapes. Standards of length.
Heliotropes.
Mercurial and aneroid barometers. Barograph.
Thermometers, maximum and minimum. Thermograph.
Anemometer Hygrometer. Psychrometers.
Rain gauge. Evaporimeters. Sunshine recorder.

Text books:—
Baldwin—On the Measurement of Nine Bases.
Breed and Hosmer—Vol. II., Chapters I., III., VIII. and IX.
Chauvenet—Practical Astronomy, Vol. II., Chapters II., III., IV., V., and VII.
Crandall—Geodesy and Least Squares, Chapters II., III., IV. and V.
Hayford—A Test of a Transit Micrometer.
Hayford—Precise Levelling.
Johnson—Surveying, Chapter XIV.
Stanley—Surveying Instruments.
Waldo—Meteorology, Chapter II.
Woodward—On the Measurement of the Holton Base Line.

Geometrical Optics.

The fundamental laws.
Geometrical theory of optical images. Geometrical constructions.
Physical conditions of image formation. Seidel's theory of the five aberrations. Old and new achromats. Computation of lenses.
Apertures and the effects depending upon them.
Optical instruments.

Text books:—
Drude—Theory of Optics, Chapters I., II., III., IV., and V.
Heath—Geometrical Optics, Sections 47 to 51, 67 to 69, 104 to 118, 124 to 155.
Lummer—Photographic Optics, Chapters I. to IX., Appendices II. and III.

Gravity and Terrestrial Magnetism.

Elementary principles of Dynamics with special reference to the case of oscillations about a fixed axis.
Definitions of velocity, acceleration, mass, density, momentum, moment of inertia, radius of gyration, centre of oscillation, &c.

Units of length, time and mass, and derived units. Dimensions of derived units. Transformation from one system of units to another.

The use of the pendulum to determine the value of gravity. Kater's pendulum; Mendenhall ½ seconds pendulum.

Relation between the value of gravity and the figure of the earth.

Methods of determining the terrestrial magnetic elements.

Magnetometer; the dip circle.

Determination of magnetic intensity with the dip circle (Lloyd's method).

Distribution of terrestrial magnetism on the earth's surface. Lines of equal declination, inclination and intensity. Poles.

Text books:—

Nipher—Magnetic Measurements.

Schott—Magnetism, Appendix No. 8, U.S.C. & G. Survey, 1881.

Smithsonian Physical Tables.

Meteorology, Geology and Mineralogy.

Meteorology.

Apparatus and methods for the measurement of temperature, atmospheric pressure, wind, atmospheric moisture, precipitation, cloud and sunshine.

Thermodynamics of the atmosphere. Isothermal and adiabatic changes. Potential temperature. Temperature gradients.

General motions of the atmosphere. Theory of the general circulation.

Secondary motions of the atmosphere. Cyclones and anticyclones.

Applied meteorology. Oscillations in climates. Meteorology applied to agriculture.

Text book:—

Waldo—Modern Meteorology.

Geology and Mineralogy.

Rock-forming minerals. Principles of classification.

Igneous rocks. Aqueous and eolian rocks. Metamorphic rocks.

Stratification and the formation of rock-beds. Concretionary and secretionary structures Inclination and curvature of strata. Joints, faults or dislocations.

Eruptive rocks. Metamorphism. Ore-formations.
Geological surveying.
Economic aspects of geological structure. Soils and Subsoils. Surface features.

Text book:—
GEIKIE—Structural and Field Geology.

TEXT BOOKS RECOMMENDED.

Appendix to the Manual of Survey.
BALDWIN—On the Measurement of Nine Base Lines, Appendix No. 3, U.S.C. & G. Survey, 1901.
BREED AND HOSMER—The Principles and Practice of Surveying.—2 Vols., *Wiley & Sons.*
BURRARD—Handbook of Professional Instructions for the Trigonometrical Branch, Survey of Indian Dept., *Government Printing Office, Calcutta,—Henry L. King & Co.*, 65 *Cornhill, London, Eng.*
CHANDLER—Elements of the Infinitesimal Calculus, *Wiley & Sons.*
CHAUVENET—Plane and Spherical Trigonometry, *Lippincott.*
CHAUVENET—Spherical and Practical Astronomy, *Lippincott.*
CHURCH—Descriptive Geometry, *The American Book Co.*
CLARKE—Construction of Maps, in article "Geography," Vol X., Encyclopedia Brittanica.
CLOSE—Text books of Topographical and Geographical Surveying, *His Majesty's Stationery Office, Wyman & Sons, Ltd., Fetter Lane, London, E.C.*
CRANDALL—Text book on Geodesy and Least Squares, *Wiley & Sons.*
DRUDE—The Theory of Optics, *Longmans, Green & Co.*
GEIKIE—Structural and Field Geology, *D. Van Nostrand & Co.*
GORE—Elements of Geodesy, *Wiley & Sons.*
HALL AND KNIGHT—Higher Algebra, *The Macmillan Co.*
HAYFORD—Precise Levelling in the United States, Appendix No. 3, U.S.C. & G. Survey, 1903.
HAYFORD—Triangulation Southward along the 98th Meridian, Appendix No. 4, U.S.C. & G. Survey, 1903.
HAYFORD—A Test of a Transit Micrometer, Appendix No 8, U.S.C. & G. Survey, 1904.
HEATH—Elementary Treatise on Geometrical Optics, 2nd Edition, *Cambridge University Press.*
JOHNSON—Theory and Practice of Surveying, *Wiley & Sons.*
LODGE—Integral Calculus, *George Bell & Sons.*

LUMMER—Photographic Optics, *Macmillan & Co.*
—Manual of Instructions for the Survey of Dominion Lands.
MERRIMAN—Precise Surveying and Geodesy, *Wiley & Sons.*
MERRIMAN—Text book on the Method of Least Squares, *Wiley & Sons.*
MIDDLETON AND CHADWICK—A Treatise on Surveying, *E. & F. N. Spon.*
NEWCOMB—Compendium of Spherical Astronomy, *The Macmillan Co.*
NIPHER—Theory of Magnetic Measurements, *Van Nostrand.*
SCHOTT—Magnetism, Appendix No. 8, U.S.C. & G. Survey, 1881.
SMITH—Conic Sections, *The Macmillan Co.*
SMITH—Solid Geometry, *The Macmillan Co.*
SNOWBALL—Plane and Spherical Trigonometry, *The Macmillan Co.*
—Smithsonian Physical Tables, *U. S. Smithsonian Institution.*
STANLEY—Surveying and Levelling Instruments, *E. & F. N. Spon.*
TODHUNTER AND LEATHEM—Spherical Trigonometry, *The Macmillan Co.*
WALDO—Modern Meteorology, *Charles Scribner's Sons.*
WILLIAMSON—Differential Calculus, *Longmans, Green & Co.*
WILLIAMSON—Integral Calculus, *Longmans, Green & Co.*
WOODWARD—On the Measurement of the Holton Base Line, Appendix No. 8, U.S.C. & G. Survey, 1892.

RULES AND REGULATIONS

OF THE

BOARD OF EXAMINERS

FOR

DOMINION LAND SURVEYORS

AND

PROGRAMME OF THE SUBJECTS

OF THE

VARIOUS EXAMINATIONS

OTTAWA
GOVERNMENT PRINTING BUREAU
1911

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RULES AND REGULATIONS

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BOARD OF EXAMINERS FOR DOMINION LAND SURVEYORS.

Regular annual examinations.

1. (*a*) The regular annual examination for admission as articled pupil, for Commission as Dominion Land Surveyor, and for Certificate as Dominion Topographical Surveyor begins on the Tuesday following the second Monday in February and continues day by day until completed.

It is held at Ottawa ~~and at such other place or places as the Minister may direct.~~ or places

Special Examinations.

(*b*) Examinations held at other times by the direction of the Minister (D.L.S. Act, s. 12) are known as Special Examinations.

Full Preliminary Examination.

2. (*a*) The examination for admission as articled pupil is known as the Full Preliminary Examination. The particulars are given in Schedule A.

(*b*) Candidates who come under the provisions of section 22 of the Dominion Lands Surveys Act, and candidates who hold university or college degrees in Arts or Science, and who in obtaining such degrees have followed a regular course of study in the mathematical subjects prescribed for the Full Preliminary Examination during the regular university or college sessions for at least two years, may at their option, take an examination consisting of two papers comprising the subjects of the Full Preliminary Examination. This examination is known as the Limited Preliminary Examination. The particulars are given in Schedule B.

Limited Preliminary Examination.

Final Examination.

(*c*) The examination for Commission as Dominion Land Surveyor is known as the Final Examination for Dominion Land Surveyor. The particulars are given in Schedule C.

D. T. S. Examination.

(*d*) The examination for Certificate as Dominion Topographical Surveyor is known as the Examination for Dominion Topographical Surveyor. The particulars are given in Schedule E.

Final Examination for holders of provincial certificates.

3. Surveyors holding provincial certificates and applying for examination under section 21 of the Dominion Lands Surveys Act shall submit such certificates to the Board along with their applications, and such further evidence as to their service under articles as the Board may require. The term of service, if insufficient, must be completed before examination.

The subjects of examination for surveyors holding provincial certificates are mentioned in Schedule D of these Rules.

4. The clause of the Dominion Lands Act under which surveyors from His Majesty's dominions, other than Canada, could

come up for final examination after one year's service as pupil with a Dominion Land Surveyor, has been abrogated by the Dominion Lands Surveys Act, 1908.

Meeting of Board prior to examinations.

5. The Board of Examiners will meet prior to each examination to consider the qualifications of these candidates whose applications have been received, and will continue to sit until the examination and the business of the Board are finished.

Time-tables for examinations.

6. For examinations held simultaneously at various places, the examination questions are the same for the respective schedules, and according to time-tables supplied by the Board of Examiners.

Examination papers.

7. Before each examination, the question papers are prepared by the Board of Examiners and the necessary copies forwarded to the presiding examiners at the different places.

Hours of examinations.

8. The examination sittings shall begin at 9.00 a.m. and continue until 12.00 m.; they shall begin again at 1.30 p.m. and continue until 4.30 p.m. daily, except Sundays, until the completion of the examination.

Candidates to present themselves punctually.

9. Candidates are to present themselves punctually at the hours appointed for the commencement of the examinations, and no candidate will be allowed to enter the examination room later than fifteen minutes after the time; nor will any candidate be allowed to leave the room during a sitting—save in case of extreme necessity; but as soon as he has finished his papers, he may hand them to the examiner and retire until the next sitting.

Candidates not to obtain assistance.

10. Candidates must not bring into the examination room any books, papers or notes, except such as are necessary in the solution of problems, and have been submitted to the presiding examiner.

Should it appear to the presiding examiner during an examination, or to the members of the Board during the reading of the answers, that any candidate has broken this rule, or has obtained assistance from any other candidate, the papers of such candidate obtaining assistance shall be cancelled. The candidate from whom such assistance was obtained shall be held to be equally guilty, and shall be dealt with accordingly.

Silence in examination room.

11. Silence shall be observed by the candidates in the examination room while the examination is in progress.

Rules to be read to cabdidates.

12. Before the beginning of the examination, the Secretary of the Board, or the presiding examiner, shall read over and make clear to the candidates the clauses of these Rules relating to the conduct of examinations, laying special stress on those parts referring to the obtaining of assistance and to the method of signing and arranging the answer papers.

Stationery supplied by Board.

13. The stationery required for examinations is supplied by the Board. The answers shall be written in ink (except

necessary diagrams, which may be in pencil), and on one side only of the paper.

14. Each sheet of paper shall have at the top the name of the subject, the number of the question, and the name of the candidate. A margin shall be left along the left hand side of the sheet. Information on each sheet.

15. Not more than one answer shall be written on the same sheet of paper.

16. The candidate shall not write on one line more than one step in geometrical or algebraic work. A single step may cover several lines, but two or more should in no instance be put on the same line. They should be put thus:— Method of arranging answers.

Because	$A = B$
And	$B = C$
Therefore	$A = C$

In additions or subtractions, numbers shall be written under each other.

17. Before handing in his answer papers, the candidate shall arrange the sheets in the order of the questions (not in the order in which he may have answered the questions), shall page them consecutively, and fasten them together at the left hand upper corner. The sheets are not to be folded. Candidates to arrange sheets.

18. No person other than the members of the Board, the presiding examiner, the Secretary and the candidates shall be admitted into the examination room while the candidates are writing. Only certain persons admitted to examination room.

19. No candidate will be considered to have passed in any examination unless he has obtained at least 50 per cent of the maximum number of marks in each subject of such examination, with the exception of the Manual of Survey for which he must have obtained at least 80 per cent of the maximum. Percentage required.

20. (*a*) A candidate who has failed in not more than half of the number of subjects may present himself subsequently for examination in such subjects, but this rule does not apply to the Limited Preliminary Examination. Supplemental Examination.

(*b*) A candidate at such Supplemental Examination who fails in more than two subjects, is not allowed a further Supplemental Examination. Should he again present himself he must take the whole examination. Those who fail in one or in two subjects are allowed a Second Supplemental Examination. Second Supplemental Examination.

(*c*) A candidate at such Second Supplemental Examination who fails in any subject is not allowed any further Supplemental Examination. Should he again present himself, he must take the whole examination.

(*d*) Candidates for the examination for Dominion Topographical Surveyor may take it in two parts as indicated in Schedule E, provided they give notice of their intention to the Secretary Candidates for D. T. S. Examination.

at least one month before the meeting. They will be allowed Supplemental Examinations in each part as provided in the rules.

Marks supplied on request.

21. The Secretary is authorized to furnish to any candidate who applies for it, a list of his marks in the different subjects, but not the marks for the individual questions.

Term of service not complete.

22. The Board will not admit to the Final Examination for Dominion Land Surveyor any pupil whose term of service at the opening of the examination is not completed, or within three weeks of completion.

In the latter case if the candidate is successful in passing the examination, the Commission as Dominion Land Surveyor will not issue until the completion of his term of service.

Candidates to bring transit theodolite.

23. Each candidate for the Final Examination shall bring with him a transit theodolite, reading at least to one minute, and he shall also submit a plan on drawing paper and field notes of a survey, all made by himself, which shall be filed with the papers in Practical Surveying.

Tables supplied.

24. Chambers's Mathematical Tables are to be used at all examinations, and copies will be supplied to those candidates who do not bring their own.

Astronomical Almanacs supplied.

25. Astronomical Almanacs are supplied by the Board to candidates at the Final Examination.

26. The apparent or presumed results of the examination are not communicated to any person until the same have been officially announced.

Duties of presiding examiner.

27. Special examiners appointed under section 12 of the Dominion Lands Surveys Act shall, after the completion of the examination under their supervision, return to the Secretary for the consideration of the Board the written answers of the candidates. They shall further examine the candidates at the Final Examination in the use of instruments, in practical surveying, in the keeping and plotting of field notes, and in the taking of astronomical observations; and shall report to the Board on all these matters.

At special Examinations fees of presiding examiner paid by candidates.

28. Candidates who desire Special Examinations are required to pay to the credit of the Receiver General the fees of the examiner, and also his travelling and living expenses when he holds the examination at a place other than that in which he usually resides.

The fees of the examiner are five dollars per diem.

The aforesaid amounts, as well as the fees provided by the Act, must be paid before the examination takes place.

When several candidates present themselves at the same time the fees and the expenses of the examiner are charged to them in proper proportions.

29. Blank forms for articles of apprenticeship, transfer of articles, oaths of allegiance and of office, and bonds, are supplied by the Secretary to those entitled to receive them. Blank forms supplied by Secretary.

30. All correspondence intended for the Board must be addressed:"Secretary, Board of Examiners for Dominion Land Surveyors, Department of the Interior, Ottawa." Correspondence addressed to Secretary.

Fees should be remitted by registered letter, or by Post Office Money Order, or Express Money Order payable to the order of the Secretary.

Articles of apprenticeship and documents of value must be sent by registered mail.

31. Articles of apprenticeship, bonds, etc., improperly executed are returned to the sender if the imperfection is noticed; and it rests with him to have the necessary corrections made. The Board assumes no responsibility in the matter.

SCHEDULE A.

Full Preliminary Examination.

	Marks.
Penmanship	50
Orthography	200
Arithmetic and Logarithms	100
Algebra	100
Plane Geometry	200
Plane Trigonometry	100
Spherical Trigonometry	100
Mensuration ~~of Superficies.~~	100

For each error in orthography in the paper entitled "Penmanship and Orthography" a deduction of 10 marks is made.

Time required, four days.

SCHEDULE B.

Limited Preliminary Examination.

	Marks.
Penmanship	50
Orthography	200
The Mathematical Subjects	700

In order to pass, a candidate must make 50% in each of the subjects, Penmanship and Orthography, and 50% in the Mathematical Subjects. For each error in the paper entitled "Penmanship and Orthography," a deduction of 10 marks is made.

Time required, one day.

SCHEDULE C.

Final Examination for Dominion Land Surveyor under Section 23 of the Dominion Lands Surveys Act.

	Marks.
Plane Geometry	150
Solid Geometry	75
Spherical Trigonometry	125
Measurement of Areas and Subdivision of Land.	200
Descriptions for Deeds	100
Astronomy (including observing)	250
Manual of Surveys and Dominion Lands Surveys Act	200
Practical Surveying	200

Time required, six days.

SCHEDULE D.

Final Examination for Dominion Land Surveyor under section 21 of the Dominion Lands Surveys Act.

	Marks.
Penmanship	50
Orthography	200
Algebra	100
Plane Geometry	150
Solid Geometry	75
Spherical Trigonometry	125
Measurement of Areas and Subdivision of Land	200
Descriptions for Deeds	100
Astronomy (including observing)	250
Manual of Survey and Dominion Lands Surveys Act	200
Practical Surveying	200

For each error in orthography in the paper entitled "Penmanship and Orthography," a deduction of 10 marks is made.

Time required, seven days.

SCHEDULE E.

Examinations for Dominion Topographical Surveyor.

Part I.

	Marks.
Algebra	50
Plane and Spherical Trigonometry	75
Analytical Geometry	100
Descriptive Geometry and Projections	75
Differential and Integral Calculus	100
Probability and Least Squares	150

Time required, three days.

Part II.

	Marks.
Geodesy	125
Astronomy	250
System of Dominion Land Surveys; topographical and exploratory surveys	150
Theory, Construction and Adjustment of Instruments	150
Gravity and Terrestrial Magnetism	100
Meteorology, Geology and Mineralogy	75

Time required, three and one-half days.

PROGRAMME OF THE SUBJECTS

OF THE

VARIOUS EXAMINATIONS BEFORE THE BOARD OF EXAMINERS FOR DOMINION LAND SURVEYORS.

FULL PRELIMINARY AND LIMITED PRELIMINARY EXAMINATIONS.

Penmanship and Orthography.

A paper or dictation of about 280 words will be given.
More than ten errors will cause the rejection of the candidate.
Candidates may write either in English or in French.

Arithmetic and Logarithms.

Greatest common measure and least common multiple.
Vulgar and decimal fractions.
Measures of length, capacity, area, weight, time and currency.
Square and cube root.
Interest and discount.
Use of Logarithmic tables.

Algebra.

Highest common divisor.
Lowest common multiple.
Factoring.
Simplification of expressions.
Equations of the first degree of one or more unknown quantities.
Quadratic equations and equations solved like quadratics.
Problems depending for their solution upon algebraic equations.

Text book:—
HALL AND KNIGHT—Elementary Algebra.

Plane Geometry.

Euclid's Elements—first four books, the sixth book and the definitions of the fifth; or,
Legendre's Géométrie—first four books.
Deductions from the propositions.
Questions as to the propositions, their practical applications, and the arithmetical or algebraic propositions corresponding to those propositions which relate to lengths of lines or areas.

Text books:—

HALL AND STEVENS—Euclid's Elements, Books I. to VI., and XI.; or,
LEGENDRE—Eléments de Géométrie, or,
TAYLOR—Euclid's Elements of Geometry.

Plane Trigonometry.

Measures of angles and arcs; the trigonometric ratios; fundamental formulæ.
Signs of trigonometric ratios.
Solution of plane triangles: right angled and oblique.
Problems depending upon the foregoing.

Text book:—
HALL AND KNIGHT—Elementary trigonometry.

Spherical Trigonometry.

Fundamental formulæ; Napier's analogies; circular parts.
Solution of spherical triangles: right angled, quadrantal and oblique.
Problems depending for their solution upon the foregoing.

Text book:—
TODHUNTER AND LEATHEM—Spherical Trigonometry.

Mensuration ~~of Superficies.~~

Areas of rectilinear figures, and of figures bounded by arcs of circles.
Areas of surfaces of right circular cones, circular cylinders, spheres, prisms, pyramids and parallelopipeda.

Text book:—
KNOTT AND MACKAY—Practical Mathematics.

TEXT BOOKS RECOMMENDED.

HALL AND KNIGHT—Elementary Algebra, *Macmillan & Co.*
HALL AND KNIGHT—Elementry Trigonometry, *Macmillan & Co.*
HALL AND STEVENS—Euclid's Elements, Books I. to VI., and XI., *Macmillan &Co.*
KNOTT AND MACKAY—Practical Mathematics, *Van Nostrand.*
LEGENDRE—Eléments de Géométrie, *Firmin Didot.*
TAYLOR—Euclid's Elements of Geometry, *Macmillan & Co.*
TODHUNTER AND LEATHEM—Spherical Trigonometry, *Macmillan & Co.*

FINAL EXAMINATION FOR DOMINION LAND SURVEYOR.

Penmanship and Orthography.

The candidates write on the same paper as those taking the Preliminary Examination. See Page 10.

Algebra.

The limits of the work are the same as for the Preliminary Examination. See page 10.

Plane Geometry and Mensuration.

First four and sixth books of Euclid's Elements, and the definitions of the fifth; or first four books of Legendre's Géométrie.

Proofs of the propositions and of deduced propositions.

Questions on the propositions.

Mensuration of plane figures bounded by straight lines or circular arcs, and of the surfaces of solids having either plane or spherical, conical or cylindrical boundaries.

Application of Geometry to plotting, and to surveying without angular instruments.

Text books:—

Hall and Stevens—Euclid's Elements, Books I. to VI., and XI.

Knott and Mackay—Practical Mathematics.

Legendre—Eléments de Géométrie.

Solid Geometry and Spherical Trigonometry.

Legendre's Géométrie, or the eleventh book of Euclid's Elements. Definitions, proofs and applications of the propositions, and deductions therefrom.

The volume of solid bodies bounded by plane, spherical, conical, or cylindrical surfaces.

Great and small circles of the sphere—Angles between great circles.

General propositions relating to the angles and sides of spherical triangles—The polar triangle.

Proofs of the fundamental formulæ connecting the sides and angles of a spherical triangle.

Deduction of the formulæ for the solution of right angled. quadrantal, and oblique angled triangles.

The conditions of ambiguity of solution of spherical triangles.

Solution of given triangles and of problems depending for their solution upon spherical trigonometry.

Spherical excess.

Text book:—

Legendre—Eléments de Géométrie, or,

Taylor—Euclid's Elements of Geometry, or,

Todhunter—Elements of Euclid.

Todhunter and Leathem—Spherical Trigonometry.

Astronomy.

The celestial sphere—Spherical coördinates, altitude and azimuth, declination and hour angle, declination and right ascension, celestial latitude and longitude

Coördinates of the observer's position.

Application of spherical trigonometry to the transformations from one system to another. Solution of the astronomical triangle.

Time:—Sidereal and solar day; apparent and mean solar time; equation of time; astronomical and civil time; standard time; transformation of one kind of time into another.

The use of the Ephemeris or Nautical Almanac.

Simple interpolation, and interpolation by second differences.

Astronomical refraction; tables of refraction.

Correction to be applied to the observed altitude of the sun, moon, or a star.

Calculation of the latitude of a place from an observation of the meridian altitude of the sun or a star, and from an altitude of a star on the prime vertical.

Calculation of the local time and the azimuth from an observed altitude of the sun or a star.

Calculation of the direction of the meridian from an observation of a circumpolar star at its greatest elongation, or at any hour angle.

Candidates will be expected to take these observations for time, latitude and azimuth, with an instrument in the presence of the Board.

Text book:—

GREENE—Spherical and Practical Astronomy.

Measurement of Areas and Subdivision of Land.

Problems on the partition of land, the rectification of boundaries, and the measurement of areas.

Measurement of areas by means of latitudes and departures. Balancing the traverse. Supplying lost distances and bearings.

Text book:—

JOHNSON—Theory and practice of Surveying.

Descriptions for Deeds, &c.

Descriptions by metes and bounds.

Descriptions by sections or legal subdivisions of the Dominion Lands System.

Descriptions by lots, or parts of lots.

Drawing up affidavits as to position of lost corners, &c.

Manual of Survey and Dominion Lands Surveys Act.

The Manual of Instructions for the Survey of Dominion Lands, Chapters I., II. and III.

Those parts of the Dominion Lands Surveys Act which relate to the re-establishment of lost corners and the division of regular and fractional sections, and to the other matters connected with the practice of surveying.

Practical Surveying.

Each candidate is expected, at some time previous to his examination, to make a survey of a piece of land having not less than five sides, and containing water, hills and other topography, and to furnish the Board at the time of his examination with his field notes of the same neatly copied and a neat plan in colours drawn by himself.

These notes and the plan will be retained by the Board.

He is further expected to bring with him to the examination a transit theodolite reading at least to minutes.

The Board will examine him as to the adjustments and use of the instruments, as to his manner of keeping rough field notes, and as to his plotting of the same.

TEXT BOOKS RECOMMENDED.

Greene—Spherical and Practical Astronomy, *Ginn & Co.*

Hall and Stevens—Euclid's Elements, Books I. to VI., and XI., *Macmillan & Co.*

Johnson—Theory and Practice of Surveying, *Wiley & Sons.*

Knott and Mackay—Practical Mathematics, *Van Nostrand.*

Lengendre—Eléments de Géométie, *Firmin Didot.*

Taylor—Euclid's Elements of Geometry, *Macmillan & Co.*

Todhunter—Elements of Euclid, *Macmillan & Co.*

Todhunter and Leathem—Spherical Trigonometry, *Macmillan & Co.*

EXAMINATION FOR DOMINION TOPOGRAPHICAL SURVEYOR.

Algebra.

Scales of notation.
Surds and imaginary quantities.
Permutations and combinations.
Binomial theroem.
Exponential and logarithmic series.
Inequalities.
Undetermined coefficients.
Recurring series.
Summation of series.
Theory of numbers.
Determinants.
Problems.

Text book:—

Hall and Knight—Higher Algebra, Chapters 7, 8, 11, 13, 14, 17, 19, 22, 24, 29, 30, and 33.

Trigonometry—Plane and Spherical.

Solution of trigonometric equations.
Development in series of trigonometric functions.
Construction of natural and logarithmic trigonometric tables.
Addition and subtraction logarithms.
Approximate solution of spherical triangles in certain cases.
On small variations in the parts of a spherical triangle.
On the connection of formulæ in Plane and Spherical Trigonometry.
Polyhedrons.
The general spherical triangle.
Examples.

Text books:—
CHAUVENET—Plane and Spherical Trigonometry. Plane, Chapters 10, 13 and 15; Spherical, Chapters 3, 4 and 7.
SNOWBALL—Plane and Spherical Trigonometry, Appendices 2 and 3.
TODHUNTER AND LEATHEM—Spherical Trigonometry, Chapters 14, 15 and 16.

Coördinate Geometry:

Two Dimensions.

Coordinates.
The straight line.
Change of axes, anharmonic ratios or cross ratios, involution.
The circle.
The parabola.
The ellipse.
Polar equation of a conic.
General equation of the second degree.
Miscellaneous propositions.

Text book:—
SMITH—Conic Sections, Chapters I. to X. (inclusive).

Three Dimensions.

Coördinates.
The plane, the straight line, transformation of coördinates.
Surfaces of the second degree.
Conicoids referred to their axes.
Plane sections of conicoids.

Surfaces in general.
Curves.
Curvatures of surfaces.

Text book:—
SMITH—Solid Geometry, Chapters I., II., III., IV., V., X., XI. and XII.

Descriptive Geometry.

Orthographic projection. Points, lines and planes. Projection of curves, tangents and normals. Curved surfaces; tangent planes and intersection by planes. Problems.

Linear perspective. Perspectives of points, straight lines and curves. Line of apparent contour. Problems.

Isometric projection. Projection of points and lines. Problems.

Text book:—

CHURCH—Descriptive Geometry, Parts I., IV., and V.

Projections.

General equation of a projection. Development and perspective projections.

Developments with the pole as a centre and when the centre is not at the pole.

Perspective projections. Point of vision on the sphere, at infinity or anywhere outside the sphere.

Conical developments.

Formulæ for the construction of the various projections. Expressions for radial and transverse scales and for errors of representation. Determination of constants for minimum misrepresentation.

Text books:—

BREED AND HOSMER—Vol. II., Chapter X.

CHURCH—Descriptive Geometry, Part II.

CLOSE AND CLARKE—Encyclopedia Britannica, Map Projections.

CLOSE—Topographical Surveying, Chapter XI.

Differential Calculus.

First principles.

Differentiation and successive differentiation.

Taylor's, Maclaurin's, John Bernouilli's series, &c.

Evaluation of indeterminate forms.

Partial differential coefficients and differentiation of functions of two or more variables.

Maxima and minima.

Tangents and normals to curves.

Asymptotes, convexity and concavity, points of inflexion, envelopes.

Curvature.

Text book:—

WILLIAMSON—Differential Calculus, Chapters 1, 2, 3, 4, 5, 6, 9, 12, 13, 15, 16 and 17.

Integral Calculus.

Integration considered as the reverse of differentiation, and also as a method of summation.

Fundamental formulæ and methods.
Principal methods of reducing integrals to integrable forms; rational fractions; reduction.
Simpson's Rule; Weddle's Rule; Edward's Rule; the Surd Rule
Determination of areas, lengths of curves, surfaces, volumes, moments of inertia, radius of gyration, centre of pressure, &c.
Elementary theory of differential equations.

Text book:—
Lodge—Integral Calculus.

Probability and Least Squares.

Probability and mean values.
General principles of the method of least squares, definitions and assumptions, deductions of the equation to the probability curve, the probability integral.
The arithmetic mean, probable error, mean square error, average error.
Rejection of observations.
Precision of observations.
Direct observations of a single quantity.
Indirect observations; normal equations; weights.
Conditional observations.
Empirical formulæ.
Application of methods to practical cases.
Text books:—
Hall and Knight—Higher Algebra, Chapter XXXII.
Merriman—Text Book on the Method of Least Squares.
Williamson—Integral Calculus, Chapter XII.

Geodesy.

Triangulation. Reconnoissance. Signals.
Base line measurement.
Trigonometric and precise levelling.
Figure of the earth.
Geodetic positions.
Determination of the dimensions of the ellipsoid.

Text books:—
Breed and Hosmer—Vol. II., Chapters I. and III.
Burrard—Instructions for Trigonometrical Branch, Part I.
Close—Topographical Surveying, Chapters II. and III.
Crandall—Geodesy and Least Squares, Chapters I., II., IV., V., VI., VII., VIII., and XI.
Gore—Geodesy, Chapters III., IV., VI., VII. and VIII.
Hayford—Triangulation along the 98th Meridian.
Hayford—Precise Levelling
Johnson—Surveying, Chapter XIV.
Merriman—Surveying and Geodesy, Chapters II., III., IV., VII., VIII., IX. and X.

Astronomy.

Different systems of spherical and rectangular coördinates.
Interpolation.
The Ephemeris or Nautical Almanac.
Reduction of star places from mean to apparent places.
Parallax; refraction; dip; semi-diameters.
Finding time—various methods; effect of small errors in data on deduced time.
Finding latitude—various methods; effect of small errors in data on deduced latitude.
Finding longitude—various methods; effect of small errors in data on deduced longitude.
Finding meridian line—various methods; effect of small errors in data on deduced azimuth.
The transit instrument—its use, including the registering micrometer.
The altitude and azimuth instrument—its use.
The zenith telescope—its use.

Text books:—
CHAUVENET—Spherical and Practical Astronomy, Vol. I., Chapters 1, 2, 4, 5, 6, 7, 9 and 11; Vol. II., Chapters 5, 7 and 8.
HAYFORD—Appendix No. 8, Report 1904, U. S. Coast and Geodetic Survey.
NEWCOMB—Compendium of Spherical Astronomy, Chapters 2, 9, 10 and 11.

System of Dominion Land Surveys; topographical and exploratory surveys.

Appendix to the Manual of Survey.
Construction and use of the Tables of the above appendix.
Problems connected with the System of Survey.
Measurement of distances by the doubly refracting prism micrometer; divided object-glass micrometer; stadia threads; movable thread micrometer; odometer; pedometer.
Determination of the bearings of a traverse with solar compass; magnetic compass; box sextant; or transit theodolite. What are the checks on the traverse?
Exploratory survey with pocket sextant, compass, micrometer, watch and aneroid; and its adjustment.
Topographic survey by aneroid; by "boiling-point" thermometer.
Latitude observations (different methods) as check on traverse.
Use of pocket chronometer for longitude—what errors may be expected.
Longitude by lunar distance; degree of accuracy.
Longitude by moon culminations with small transit; probable error of the resulting longitude.

Text books:—
Appendix to the Manual of Survey.
MIDDLETON AND CHADWICK—A Treatise on Surveying, Part II, Chapters XI., XII. and XIII.

Theory, Construction and Adjustment of Instruments.

Instruments.

Graduated circles. The vernier. Reading microscope. Micrometers. Levels.

Chronometers. Chronographs.

Sextant. Reflecting circle. Prismatic circle.

Theodolite. Altazimuth. Astronomical transit. Zenith telescope.

Precise levelling instrument. Levelling rod.

Base measuring apparatus. Tapes. Standards of length.

Heliotropes.

Mercurial and aneroid barometers. Barograph.

Thermometers, maximum and minimum. Thermograph.

Anemometer. Hygrometer. Psychrometers.

Rain gauge. Evaporimeters. Sunshine recorder.

Text books:—

Baldwin—On the Measurement of Nine Bases.

Breed and Hosmer—Vol. II., Chapters I., III., VIII., and IX.

Chauvenet—Practical Astronomy, Vol. II., Chapters II., III., IV., V., and VII.

Crandall—Geodesy and Least Squares, Chapters II., III., IV. and V.

Hayford—A Test of a Transit Micrometer.

Hayford—Precise Levelling.

Johnson—Surveying, Chapter XIV.

Stanley—Surveying Instruments.

Waldo—Meteorology, Chapter II.

Woodward—On the Measurement of the Holton Base Line.

Geometrical Optics.

The fundamental laws.

Geometrical theory of optical images. Geometrical constructions.

Physical conditions of image formation. Seidel's theory of the five aberrations. Old and new achromats Computation of lenses.

Apertures and the effects depending upon them.

Optical instruments.

Text books:—

Drude—Theory of Optics, Chapters I., II., III., IV. and V.

Heath—Geometrical Optics, Sections 47 to 51, 67 to 69, 104 to 118, 124 to 155.

Lummer—Photographic Optics, Chapters I. to IX., Appendices II. and III.

Gravity and Terrestrial Magnetism.

Elementary principles of Dynamics with special reference to the case of oscillations about a fixed axis.

Definitions of velocity, acceleration, mass, density, momentum, moment of inertia, radius of gyration, centre of oscillation, &c.

Units of length, time and mass, and derived units. Dimensions of derived units. Transformation from one system of units to another.

The use of the pendulum to determine the value of gravity. Kater's pendulum; Mendenhall ½ seconds pendulum.

Relations between the value of gravity and the figure of the earth.

Methods of determining the terrestrial magnetic elements.

Magnetometer; the dip circle.

Determination of magnetic intensity with the dip circle (Lloyd's method).

Distribution of terrestrial magnetism on the earth's surface. Lines of equal declination, inclination and intensity. Poles.

Text books:—

Nipher—Magnetic Measurements.

Schott—Magnetism, Appendix No. 8, U.S.C. & G. Survey, 1881.

Smithsonian Physical Tables.

Meteorology, Geology and Mineralogy.

Meteorology.

Apparatus and methods for the measurement of temperature atmospheric pressure, wind, atmospheric moisture, precipitation, cloud and sunshine.

Thermodynamics of the atmosphere. Isothermal and adiabatic changes. Potential temperature. Temperature gradients.

General motions of the atmosphere. Theory of the general circulation.

Secondary motions of the atmosphere. Cyclones and anticyclones.

Applied meteorology. Oscillations in climates. Meteorology applied to agriculture.

Text book:—

Waldo—Modern Meteorology.

Geology and Mineralogy.

Rock-forming minerals. Principles of classification.

Igneous rocks. Aqueous and eolian rocks. Metamorphic rocks.

Stratification and the formation of rock-beds. Concretionary and secretionary structures. Inclination and curvature of strata. Joints, faults or dislocations.

Eruptive rocks. Metamorphism. Ore-formations.

Geological surveying.

Economic aspects of geological structure. Soils and Subsoils. Surface features.

Text book:—
GEIKIE—Structural and Field Geology.

TEXT BOOKS RECOMMENDED.

Appendix to the Manual of Survey.
BALDWIN—On the Measurement of Nine Base Lines, Appendix No. 3, U.S.C. & G. Survey, 1901.
BREED AND HOSMER—The Principles and Practice of Surveying.—2 Vols., *Wiley & Sons.*
BURRARD—Handbook of Professional Instructions for the Trigonometrical Branch, Survey of India Dept., *Government Printing Office, Calcutta,—Henry L. King & Co., 65 Cornhill, London, Eng.*
CHANDLER—Elements of the Infinitesimal Calculus, *Wiley & Sons.*
CHAUVENET—Plane and Spherical Trigonometry, *Lippincott.*
CHAUVENET—Shperical and Practical Astronomy, *Lippincott.*
CHURCH—Descriptive Geometry, *The American Book Co.*
CLOSE AND CLARKE—Map Projections, in article "Map" Vol. XVII., Encyclopedia Brittanica.
CLOSE—Text books of Topographical and Geographical Surveying, *His Majesty's Stationery Office, Wyman & Sons, Ltd., Fetter Lane, London, E.C.*
CRANDALL—Text book on Geodesy and Least Squares, *Wiley & Sons.*
DRUDE—The Theory of Optics, *Longmans, Green & Co.*
GEIKIE—Structural and Field Geology, *D. Van Nostrand & Co.*
GORE—Elements of Geodesy, *Wiley & Sons.*
HALL AND KNIGHT—Higher Algebra, *The Macmillan Co.*
HAYFORD—Precise Levelling in the United States, Appendix No. 3. U.S.C. & G. Survey, 1903.
HAYFORD—Triangulation Southward along the 98th Meridian, Appendix No. 4, U.S. C. & G. Survey, 1903.
HAYFORD—A Test of a Transit Micrometer, Appendix No. 8, U.S.C. & G. Survey, 1904.
HEATH—Elementary Treatise on Geometrical Optics, 2nd Edition, *Cambridge University Press.*
JOHNSON—Theory and Practice of Surveying, *Wiley & Sons.*
LODGE—Integral Calculus, *George Bell & Sons.*
LUMMER—Photographic Optics, *Macmillan & Co.*
—Manual of Instructions for the Survey of Dominion Lands.
MERRIMAN—Precise Surveying and Geodesy, *Wiley & Sons.*
MERRIMAN—Text book on the Method of Least Squares, *Wiley & Sons.*
MIDDLETON AND CHADWICK—A Treatise on Surveying, *E. & F. N. Spon.*
NEWCOMB—Compendium of Spherical Astronomy, *The Macmillan Co.*

NIPHER—Theory of Magnetic Measurements, *Van Nostrand.*
SCHOTT—Magnetism, Appendix No. 8, U.S.C. & G. Survey, 1881.
SMITH—Conic Sections, *The Macmillan Co.*
SMITH—Solid Geometry, *The Macmillan Co.*
SNOWBALL—Plane and Spherical Trigonometry, *The Macmillan Co.*
—Smithsonian Physical Tables, *U. S. Smithsonian Institution.*
STANLEY—Surveying and Levelling Instruments, *E. & F. N. Spon.*
TODHUNTER AND LEATHEM—Spherical Trigonometry, *The Macmillan Co.*
WALDO—Modern Meteorology, *Charles Scribner's Sons.*
WILLIAMSON—Differential Calculus, *Longmans, Green & Co.*
WILLIAMSON—Integral Calculus, *Longmans, Green & Co.*
WOODWARD—On the Measurement of the Holton Base Line, Appendix No. 8, U.S.C. & G. Survey, 1892.

RULES AND REGULATIONS

OF THE

BOARD OF EXAMINERS FOR DOMINION LAND SURVEYORS

AND PROGRAMME OF THE SUBJECTS OF THE VARIOUS EXAMINATIONS

OTTAWA
GOVERNMENT PRINTING BUREAU
1912

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RULES AND REGULATIONS

OF THE

BOARD OF EXAMINERS FOR DOMINION LAND SURVEYORS.

Regular annual examinations.

1. (*a*) The regular annual examination for admission as articled pupil, for Commission as Dominion Land Surveyor, and for Certificate as Dominion Topographical Surveyor begins on the Tuesday following the second Monday in February and continues day by day until completed. It is held at Ottawa.

Special Examinations.

(*b*) Examinations held at other times or places by the direction of the Minister (D.L.S. Act, s. 12) are known as Special Examinations.

Full Preliminary Examination.

2. (*a*) The examination for admission as articled pupil is known as the Full Preliminary Examination. The particulars are given in Schedule A.

(*b*) Candidates who come under the provisions of section 22 of the Dominion Lands Surveys Act, and candidates who hold university or college degrees in Arts or Science, and who in obtaining such degrees have followed a regular course of study in the mathematical subjects prescribed for the Full Preliminary Examination during the regular university or college sessions for at least two years, may at their option, take an examination consisting of two papers comprising the subjects of the Full Preliminary Examination. This examination is known as the Limited Preliminary Examination. The particulars are given in Schedule B.

Limited Preliminary Examination.

Final Examination.

(*c*) The examination for Commission as Dominion Land Surveyor is known as the Final Examination for Dominion Land Surveyor. The particulars are given in Schedule C.

D. T. S. Examination.

(*d*) The examination for Certificate as Dominion Topographical Surveyor is known as the Examination for Dominion Topographical Surveyor. The particulars are given in Schedule E.

Final Examination for holders of provincial certificates.

3. Surveyors holding provincial certificates and applying for examination under section 21 of the Dominion Lands Surveys Act shall submit such certificates to the Board along with their applications, and such further evidence to their service under articles as the Board may require. The term of service, if insufficient, must be completed before examination.

The subjects of examination for surveyors holding provincial certificates are mentioned in Schedule D of these Rules.

4. The clause of the Dominion Lands Act under which surveyors from His Majesty's dominions, other than Canada, could

come up for final examination after one year's service as pupil with a Dominion Land Surveyor, has been abrogated by the Dominion Lands Surveys Act, 1908.

Meeting of Board prior to examinations.

5. The Board of Examiners will meet prior to each examination to consider the qualifications of those candidates whose applications have been received, and will continue to sit until the examination and the business of the Board are finished.

Time-tables for examinations.

6. For examinations held simultaneously at various places, the examination questions are the same for the respective schedules, and according to time-tables supplied by the Board of Examiners.

Examination papers.

7. Before each examination, the question papers are prepared by the Board of Examiners and the necessary copies forwarded to the presiding examiners at the different places.

Hours of examinations.

8. The examination sittings shall begin at 9.00 a.m. and continue until 12.00 a.m.; they shall begin again at 1.30 p.m. and continue until 4.30 p.m. daily, except Sundays, until the completion of the examination.

Candidates to present themselves punctually.

9. Candidates are to present themselves punctually at the hours appointed for the commencement of the examinations, and no candidate will be allowed to enter the examination room later than fifteen minutes after the time; nor will any candidate be allowed to leave the room during a sitting—save in case of extreme necessity; but as soon as he has finished his papers, he may hand them to the examiner and retire until the next sitting.

Candidates not to obtain assistance.

10. Candidates must not bring into the examination room any books, papers or notes, except such as are necessary in the solution of problems, and have been submitted to the presiding examiner.

Should it appear to the presiding examiner during an examination, or to the members of the Board during the reading of the answers, that any candidate has broken this rule, or has obtained assistance from any other candidate, the papers of such candidate obtaining assistance shall be cancelled. The candidate from whom such assistance was obtained shall be held to be equally guilty, and shall be dealt with accordingly.

Silence in examination room.

11. Silence shall be observed by the candidates in the examination room while the examination is in progress

Rules to be read to candidates.

12. Before the beginning of the examination, the Secretary of the Board, or the presiding examiner, shall read over and make clear to the candidates the clauses of these Rules relating to the conduct of examinations, laying special stress on those parts referring to the obtaining of assistance and to the method of signing and arranging the answer papers.

Stationery supplied by Board.

13. The stationery required for examinations is supplied by the Board. The answers shall be written in ink (except necessary diagrams, which may be in pencil), and on one side only of the paper.

14. Each sheet of paper shall have at the top the name of the subject, the number of the question, and the name of the candidate. A margin shall be left along the left hand side of the sheet. Information on each sheet.

15. Not more than one answer shall be written on the same sheet of paper.

16. The candidate shall not write on one line more than one step in geometrical or algebraic work. A single step may cover several lines, but two or more should in no instance be put on the same line. They should be put thus:— Method of arranging answers.

Because $A = B$
And $B = C$
Therefore $A = C$

In additions or subtractions, numbers shall be written under each other.

17. Before handing in his answer papers, the candidate shall arrange the sheets in the order of the questions (not in the order in which he may have answered the questions), shall page them consecutively, and fasten them together at the left hand upper corner. The sheets are not to be folded. Candidates to arrange sheets.

18. No person other than the members of the Board, the presiding examiner, the Secretary and the candidates shall be admitted into the examination room while the candidates are writing. Only certain persons admitted to examination room.

19. No candidate will be considered to have passed in any examination unless he has obtained at least 50 per cent of the maximum number of marks in each subject of such examination, with the exception of the Manual of Survey for which he must have obtained at least 80 per cent of the maximum. Percentage required.

20. (*a*) A candidate who has failed in not more than half of the number of subjects may present himself subsequently for examination in such subjects, but this rule does not apply to the Limited Preliminary Examination. Supplemental Examination.

(*b*) A candidate at such Supplemental Examination who fails in more than two subjects, is not allowed a further Supplemental Examination. Should he again present himself he must take the whole examination. Those who fail in one or in two subjects are allowed a Second Supplemental Examination. Second Supplemental Examination.

(*c*) A candidate at such Second Supplemental Examination who fails in any subject is not allowed any further Supplemental Examination. Should he again present himself, he must take the whole examination.

(d) Candidates for the examination for Dominion Topographical Surveyor may take it in two parts as indicated in Schedule E, provided they give notice of their intention to the Secretary at least one month before the meeting. They will be allowed Supplemental Examinations in each part as provided in the rules Candidates for D.T.S. Examination.

Marks supplied to candidates.

21. The Secretary is authorized to furnish to any candidate a list of his marks in the different subjects, but not the marks for the individual questions.

Service under articles.

22. A pupil who becomes articled immediately upon receiving notice that he has successfully passed the preliminary examination may, in the discretion of the Board, notwithstanding that he has not completed his term of service, be allowed to present himself for final examination at the meeting of the Board held one year or three years as the case may be, after the date of his preliminary examination, provided his service has been continuous since he became articled and the field service is complete; but he will be required to complete his term of service under the articles in order to become eligible for a commission as a Dominion Land Surveyor.

Candidates to bring transit theodolite.

23. Each candidate for the Final Examination shall bring with him a transit theodolite, reading at least to one minute, and he shall also submit a plan on drawing paper and field notes of a survey, all made by himself as indicated by a certificate to that effect. The plan and notes shall be filed with the papers in Practical Surveying.

Tables supplied.

24. Chambers's Mathematical Tables are to be used at all examinations, and copies will be supplied to those candidates who do not bring their own.

Astronomical Almanacs supplied.

25. Astronomical Almanacs are supplied by the Board to candidates at the Final Examination.

26. The apparent or presumed results of the examination are not communicated to any person until the same have been officially announced.

Duties of presiding examiner.

27. Special examiners appointed under section 12 of the Dominion Lands Surveys Act shall, after the completion of the examination under their supervision, return to the Secretary for the consideration of the Board the written answers of the candidates. They shall further examine the candidates at the Final Examination in the use of instruments, in practical surveying, in the keeping and plotting of field notes, and in the taking of astronomical observations; and shall report to the Board on all these matters.

At special Examinations fees of presiding examiner paid by candidates.

28. Candidates who desire Special Examinations are required to pay to the credit of the Receiver General the fees of the examiner, and also his travelling and living expenses when he holds the examination at a place other than that in which he usually resides.

The fees of the examiner are five dollars per diem.

The aforesaid amounts, as well as the fees provided by the Act, must be paid before the examination takes place.

When several candidates present themselves at the same time the fees and the expenses of the examiner are charged to them in proper proportions.

29. Blank forms for articles of apprenticeship, transfer of articles, oaths of allegiance and of office, and bonds, are supplied by the Secretary to those entitled to receive them. Blank forms supplied by Secretary.

30. All correspondence intended for the Board must be addressed: "Secretary, Board of Examiners for Dominion Land Surveyors, Department of the Interior, Ottawa." Correspondence addressed to Secretary.

Fees should be remitted by registered letter, or by Post Office Money Order, or Express Money Order payable to the order of the Secretary. If cheques are sent they must be made to cover the cost of exchange.

Articles of apprenticeship and documents of value must be sent by registered mail.

31. Articles of apprenticeship, bonds, etc., improperly executed are returned to the sender if the imperfection is noticed; and it rests with him to have the necessary corrections made. The Board assumes no responsibility in the matter.

SCHEDULE A.

Full Preliminary Examination

	Marks.
Penmanship	50
Orthography	200
Arithmetic and Logarithms	100
Algebra	100
Plane Geometry	200
Plane Trigonometry	100
Spherical Trigonometry	100
Mensuration	100

For each error in orthography in the paper entitled "Penmanship and Orthography" a deduction of 10 marks is made.

Time required, four days.

SCHEDULE B.

Limited Preliminary Examination

	Marks.
Penmanship	50
Orthography	200
The Mathematical Subjects	700

In order to pass, a candidate must make 50% in each of the subjects, Penmanship and Orthography, and 50% in the Mathematical Subjects. For each error in the paper entitled "Penmanship and Orthography," a deduction of 10 marks is made.

Time required, one day.

SCHEDULE C.

Final Examination for Dominion Land Surveyor under Section 23 of the Dominion Lands Surveys Act.

	Marks.
Plane Geometry	150
Solid Geometry	75
Spherical Trigonometry	125
Measurement of Areas and Subdivision of Land	200
Descriptions for Deeds	100
Astronomy (including observing)	250
Manual of Surveys and Dominion Lands Surveys Act	200
Practical Surveying	200

Time required, six days.

SCHEDULE D

Final Examination for Dominion Land Surveyor under section 21 of the Dominion Lands Surveys Act.

	Marks.
Penmanship	50
Orthography	200
Algebra	100
Plane Geometry	150
Solid Geometry	75
Spherical Trigonometry	125
Measurement of Areas and Subdivision of Land	200
Descriptions for Deeds	100
Astrnoomy (including obseı ving)	250
Manual of Survey and Dominion Lands Surveys Act	200
Practical Surveying	200

For each error in orthography in the paper entitled "Penmanship and Orthography" a deduction of 10 marks is made.

Time required, seven days.

SCHEDULE E.

Examinations for Dominion Topographical Surveyor.

Part I.

	Marks.
Algebra	50
Plane and Spherical Trigonometry	75
Analytical Geometry	100
Descriptive Geometry and Projections	75
Differential and Integral Calculus	100
Probability and Least Squares	150

Time required, three days.

Part II.

	Marks.
Geodesy	125
Astronomy	250
System of Dominion Land Surveys; topographical and exploratory surveys	150
Theory, Construction and Adjustment of Instruments	150
Gravity and Terrestrial Magnetism	100
Meteorology, Geology and Mineralogy	75

Time required, three and one-half days.

PROGRAMME

OF THE SUBJECTS OF THE VARIOUS EXAMINATIONS BEFORE THE BOARD OF EXAMINERS FOR DOMINION LAND SURVEYORS.

FULL PRELIMINARY AND LIMITED PRELIMINARY EXAMINATIONS.

Penmanship and Orthography.

A paper or dictation of about 280 words will be given.
More than ten errors will cause the rejection of the candidate.
Candidates may write either in English or in French.

Arithmetic and Logarithms.

Greatest common measure and least common multiple.
Vulgar and decimal fractions.
Measures of length, capacity, area, weight, time and currency
Square and cube root.
Interest and discount.
Use of Logarithmic tables.

Algebra.

Highest common divisor.
Lowest common multiple.
Factoring.
Simplification of expressions.
Equations of the first degree of one or more unknown quantities.
Quadratic equations and equations solved like quradratics.
Problems depending for their solution upon algebraic equations.

Text book:—

HALL AND KNIGHT—Elementary Algebra.

Plane Geometry.

Euclid's Elements—first four books, the sixth book and the definitions of the fifth; or,
Legendre's Géométrie—first four books.
Proofs of the propositions and simple deductions from them.
Questions as to the propositions, their practical applications, and the arithmetical or algebraic propositions corresponding to those propositions which relate to lengths of lines or areas.
In proving propositions the order of the text book used (whether Euclid or Legendre) should be followed, and nothing taken as proved which has not been proved in a preceding proposition.

Text books:—

HALL AND STEVENS—Euclid's Elements, Books I. to VI., and XI.; or,
LEGENDRE—Eléments de Géométrie.

Plane Trigonometry.

Measures of angles and arcs; the trigonometric ratios; fundamental formulæ.

Signs of trigonometric ratios.

Solution of plane triangles: right angled and oblique.

Problems depending upon the foregoing.

Text book:—

HALL AND KNIGHT—Elementary trigonometry.

Spherical Trigonometry.

Fundamental formulæ, Napier's analogies; circular parts.

Solution of spherical triangles: right angled, quadrantal and oblique.

Problems depending for their solution upon the foregoing.

Text book:—

TODHUNTER AND LEATHEM—Spherical Trigonometry.

Mensuration.

Areas of rectilinear figures, and of figures bounded by arcs of circles.

Areas of surfaces and volumes of right circular cones, circular cylinders, spheres, prisms, pyramids and parallelopipeda.

Text book:—

KNOTT AND MACKAY—Practical Mathematics.

TEXT BOOKS RECOMMENDED.

HALL AND KNIGHT—Elementary Algebra, *Macmillan & Co.*

HALL AND KNIGHT—Elementry Trigonometry, *Macmillan & Co.*

HALL AND STEVENS—Euclid's Elements, Books I. to VI., and XI., *Macmillan & Co.*

KNOTT AND MACKAY—Practical Mathematics, *Van Nostrand.*

LEGENDRE—Eléments de Géométrie, *Firmin Didot.*

TODHUNTER AND LEATHEM—Spherical Trigonometry, *Macmillan & Co.*

FINAL EXAMINATION FOR DOMINION LAND SURVEYOR.

Penmanship and Orthography.

The candidates write on the same paper as those taking the Preliminary Examination. See Page 10.

Algebra.

The limits of the work are the same as for the Preliminary Examination. See page 10.

Plane Geometry and Mensuration.

First four and sixth books of Euclid's Elements, and the definitions of the fifth: or first four books of Legendre's Géométrie.

Proofs of the propositions and deduced propositions.

Questions on the propositions.

Mensuration of plane figures bounded by straight lines or circular arcs, and of the surfaces of solids having either plane or spherical, conical or cylindrical boundaries.

Application of Geometry to plotting, and to surveying without angular instruments.

Test books:—

HALL AND STEVENS—Euclid's Elements, Books I. to VI., and XI.
KNOTT AND MACKAY—Practical Mathematics.
LEGENDRE—Eléments de Géométrie.

Solid Geometry and Spherical Trigonometry.

Legendre's Géométrie, or the eleventh book of Euclid's Elements. Definitions, proofs and applications of the propositions, and deductions therefrom.

The volume of solid bodies bounded by plane, spherical, conical, or cylindrical surfaces.

Great and small circles of the sphere—Angles between great circles.

General propositions relating to the angles and sides of spherical triangles—The polar triangle.

Proofs of the fundamental formulæ connecting the sides and angles of a spherical triangle.

Deduction of the formulæ for the solution of right angled, quadrantal, and oblique angled triangles.

The conditions of ambiguity of solution of spherical triangles.

Solution of given triangles and of problems depending for their solution upon spherical trigonometry.

Spherical excess.

Text books:—

LEGENDRE—Eléments de Géométrie, or,
TAYLOR—Euclid's Elements of Geometry, or,
TODHUNTER—Elements of Euclid.
TODHUNTER AND LEATHEM—Spherical Trigonometry.

Astronomy.

The celestial sphere—Spherical coördinates, altitude and azimuth, declination and hour angle, declination and right ascension, celestial latitude and longitude.

Coördinates of the observer's position.

Application of spherical trigonometry to the transformations from one system to another. Solution of the astronomical triangle.

Time:—Sidereal and solar day; apparent and mean solar time; equation of time; astronomical and civil time; standard time; transformation of one kind of time into another.

The use of the Ephemeris or Nautical Almanac.

Simple interpolation, and interpolation by second differences.

Astronomical refraction; tables of refraction.

Correction to be applied to the observed altitude of the sun, moon, or a star.

Calculation of the latitude of a place from an observation of the meridian altitude of the sun or a star, and from an altitude of a star on the prime vertical.

Calculation of the local time and the azimuth from an observed altitude of the sun or a star.

Calculation of the direction of the meridian from an observation of a circumpolar star at its greatest elongation, or at any hour angle.

Candidates will be expected to take these observatiosn for time, latitude and azimuth, with an instrument in the presence of the Board.

Text book:—

GREENE—Spherical and Practical Astronomy.

Measurement of Areas and Subdivision of Land.

Problems on the partition of land, the rectification of boundaries, and the measurement of areas.

Measurement of areas by means of latitudes and departures. Balancing the traverse. Supplying lost distances and bearings.

Text book:—

JOHNSON—Theory and practice of Surveying.

Descriptions for Deeds, &c.

Descriptions by metes and bounds.

Descriptions by sections or legal subdivisions of the Dominion Lands System.

Descriptions by lots, or parts of lots.

Drawing up affidavits as to position of lost corners, &c.

Manual of Survey and Dominion Lands Surveys Act.

The Manual of Instructions for the Survey of Dominion Lands, Chapters I., II. and III.

Those parts of the Dominion Lands Surveys Act which relate to re-establishment of lost corners and the division of regular and fractional sections, and to the other matters connected with the practice of surveying.

Practical Surveying.

Each candidate is expected, at some time previous to his examination, to make a survey of a piece of land having not less than five sides, and containing water, hills and other topography, and to furnish the Board at the time of his examination with his field notes of the same neatly copied and a neat plan in colours drawn by himself.

These notes and the plan will be retained by the Board.

He is further expected to bring with him to the examination a transit theodolite reading at least to minutes.

The Board will examine him as to the adjustments and use of the instruments, as to his manner of keeping rough field notes, and as to his plotting of the same.

TEXT BOOKS RECOMMENDED.

GREENE—Spherical and Practical Astronomy, *Ginn & Co.*

HALL AND STEVENS—Euclid's Elements, Books I. to VI., and XI., *Macmillan & Co.*

JOHNSON—Theory and Practice of Surveying, *Wiley & Sons.*

KNOTT AND MACKAY—Practical Mathematics, *Van Nostrand.*

LENGENDRE—Eléments de Géométrie, *Firmin Didot.*

TAYLOR—Euclid's Elements of Geometry, *Macmillan & Co.*

TODHUNTER—Elements of Euclid, *Macmillan & Co.*

TODHUNTER AND LEATHEM—Spherical Trigonometry, *Macmillan & Co.*

EXAMINATION FOR DOMINION TOPOGRAPHICAL SURVEYOR.

Algebra.

Scales of notation.
Surds and imaginary quantities.
Permutations and combinations.
Binominal theorem.
Exponential and logarithmic series
Inequalities.
Undetermined coefficients.
Recurring series.
Summation of series.
Theory of numbers
Determinants.
Problems.

Text book:—

HALL AND KNIGHT—Higher Algebra, Chapters 7, 8, 11, 13, 14. 17, 19, 22, 24, 29, 30, and 33.

Trigonometry—Plane and Spherical.

Solution of trigonometric equations.
Development in series of trigonometric functions.
Construction of natural and logarithmic trigonometric tables.
Addition and subtraction logarithms
Approximate solution of spherical triangles in certain cases.
On small variations in the parts of a spherical triangle.
On the connection of formulæ in Plane and Spherical Trigonometry.
Polyhedrons.
The general spherical triangle.
Examples.

Text books:—

CHAUVENET—Plane and Spherical Trigonometry. Plane, Chapters 10, 13 and 15; Spherical, Chapters 3, 4 and 7.
SNOWBALL.—Plane and Spherical Trigonometry, Appendices 2 and 3.
TODHUNTER AND LEATHEM—Spherical Trigonometry, Chapters 14. 15 and 16.

Coördinate Geometry:

Two Dimensions.

Coordinates.
The straight line.
Change of axes, anharmonic ratios or cross ratios, involution.
The circle.
The parabola.
The ellipse.
Polar equation of a conic.
General equation of the second degree.
Miscellaneous propositions.

Text book:—

SMITH—Conic Sections, Chapters I. to X. (inclusive).

Three Dimensions.

Coördinates.
The plane, the straight line, transformation of coördinates.
Surfaces of the second degree.
Conicoids referred to their axes.
Plane sections of conicoids.
Surfaces in general.
Curves.
Curvatures of surfaces.

Text book:—

SMITH—Solid Geometry, Chapters I., II., III., IV., V., X., XI. and XII.

Descriptive Geometry.

Orthographic projection. Points, lines and planes. Projection of curves, tangents and normals. Curved surfaces; tangent planes and intersection by planes. Problems.

Linear perspective. Perspectives of points, straight lines and curves. Line of apparent contour. Problems.

Isometric projection. Projection of points and lines. Problems.

Text book:—

CHURCH—Descriptive Geometry, Parts I., IV., and V.

Projections.

General equation of a projection. Development and perspective projections.

Developments with the pole as a centre and when the centre is not at the pole.

Perspective projections. Point of vision on the sphere, at infinity or anywhere outside the sphere.

Conical developments.

Formulæ for the construction of the various projections. Expressions for radial and transverse scales and for errors of representation. Determination of constants for minimum misrepresentation.

Text books:—

BREED AND HOSMER—Vol. II., Chapter X.

CHURCH—Descriptive Geometry, Part II.

CLOSE AND CLARKE—Encyclopedia Britannica, Map Projections.

CLOSE—Topographical Surveying, Chapter XI.

Differential Calculus.

First principles.

Differentiation and successive differentiation.

Taylor's, Maclaurin's, John Bernouilli's series, &c.

Evaluation of indeterminate forms.

Partial differential coefficients and differentiation of functions of two or more variables.

Maxima and minima.

Tangents and normals to curves.

Asymptotes, convexity and concavity, points of inflexion, envelopes.

Curvature.

Text book:—

WILLIAMSON—Differential Calculus, Chapters 1, 2, 3, 4, 5, 6, 9, 12, 13, 15, 16 and 17.

Integral Calculus.

Integration considered as the reverse of differentiation, and also as a method of summation.

Fundamental formulæ and methods.

Principal methods of reducing integrals to integrable forms; rational fractions; reduction.

Simpson's Rule; Weddle's Rule; Edward's Rule; the Surd Rule.

Determination of areas, lengths of curves, surfaces, volumes, moments of inertia, radius of gyration, centre of pressure, &c.

Elementary theory of differential equations.

Text book:—

LODGE—Integral Calculus.

Probability and Least Squares.

Probability and mean values.

General principles of the method of least squares, definitions and assumptions, deductions of the equation to the probability curve, the probability integral.

The arithmetic mean, probable error, mean square error, average error.

Rejection of observations.

Precision of observations.

Direct observations of a single quantity.

Indirect observations; normal equations; weights.

Conditional observations.

Empirical formulæ.

Application of methods to practical cases.

Text books:—

HALL AND KNIGHT—Higher Alegbra, Chapter XXXII.

MERRIMAN—Text Book on the Method of Least Squares.

WILLIAMSON—Integral Calculus, Chapter XII.

Geodesy.

Triangulation. Reconnoissance. Signals.

Base line measurement.

Trigonometric and precise levelling.

Figure of the earth.

Geodetic positions.

Determination of the dimensions of the ellipsoid.

Text books:—

BREED AND HOSMER—Vol. II., Chapters I. and III.

BURRARD—Instructions for Trigonometrical Branch, Part I.

CLOSE—Topographical Surveying, Chapters II, and III.

CRANDALL—Geodesy and Least Squares, Chapters I., II., IV., V., VI., VII., VIII., and XI.

GORE—Geodesy, Chapters III., IV., VI., VII. and VIII

HAYFORD—Triangulation along the 98th Meridian.

HAYFORD—Precise Levelling.

JOHNSON—Surveying, Chapter XIV.

MERRIMAN—Surveying and Geodesy, Chapters II., III., IV., VII., VIII., IX. and X.

Astronomy.

Different systems of spherical and rectangular coördinates.
Interpolation.
The Ephemeris or Nautical Almanac.
Reduction of star places from mean to apparent places.
Parallax; refraction; dip; semi-diameters.
Finding time—various methods; effect of small errors in data on deduced time.
Finding latitude—various methods; effect of small errors in data on deduced latitude.
Finding longitude—various methods; effect of small erros in data on deduced longitude.
Finding meridian line—various methods; effect of small errors in data on deduced azimuth.
The transit instrument—its use, including the registering micrometer.
The altitude and azimuth instrument—its use.
The zenith telescope—its use.

Text books:—

CHAUVENET—Spherical and Practical Astronomy, Vol. I., Chapters 1, 2, 4, 5, 6, 7, 9 and 11; Vol. II., Chapters 5, 7 and 8.
HAYFORD—Appendix No. 8, Report 1904, U. S. Coast and Geodetic Survey.
NEWCOMB—Compendium of Spherical Astronomy, Chapters 2, 9, 10 and 11.

System of Dominion Land Surveys; topographical and exploratory surveys.

Appendix to the Manual of Survey.
Construction and use of the Tables of the above appendix.
Problems connected with the System of Survey.
Measurement of distances by the double refracting prism micrometer; divided object-glass micrometer; stadia threads; movable thread micrometer; odometer; pedometer.
Determination of the bearings of a traverse with solar compass; magnetic compass; box sextant; or transit theodolite. What are the checks on the traverse?
Exploratory survey with pocket sextant, compass, micrometer, watch and aneroid; and its adjustment.
Topographic survey by aneroid; by "boiling-point" thermomter.
Latitude observations (different methods) as check on traverse.
Use of pocket chronometer for longitude—what errors may be expected.
Longitude by lunar distance; degree of accuracy.
Longitude by moon culminations with small transit; probable error of the resulting longitude.

Text books:—

Appendix to the Manual of Survey.
MIDDLETON AND CHADWICK—A Treatise on Surveying, Part II. Chapters XI., XII. and XIII.

Theory, Construction and Adjustment of Instruments.

Instruments.

Graduated circles. The vernier. Reading microscope. Micrometers. Levels.

Chronometers. Chronographs.

Sextant. Reflecting circle. Prismatic circle.

Theodolite. Altazimuth. Astronomical transit. Zenith telescope.

Precise levelling instrument. Levelling rod.

Base measuring apparatus. Tapes. Standards of length.

Heliotropes.

Mercurial and aneroid barometers. Barograph.

Thermometers, maximum and minimum. Thermograph.

Anemometer. Hygrometer. Psychrometers.

Rain gauge. Evaporimeters. Sunshine recorder.

Text books:—

BALDWIN—On the Measurement of Nine Bases.

BREED AND HOSMER—Vol. II., Chapters I., III., VIII., and IX.

CHAUVENET—Practical Astronomy, Vol. II., Chapters II., III., IV., V., and VII.

CRANDALL—Geodesy and Least Squares, Chapters II., III., IV. and V.

HAYFORD—A Test of a Transit Micrometer.

HAYFORD—Precise Levelling.

JOHNSON—Surveying, Chapter XIV

STANLEY—Surveying Instruments.

WALDO—Meteorology, Chapter II.

WOODWARD—On the Measurement of the Holton Base Line.

Geometrical Optics.

The fundamental laws.

Geometrical theory of optical images. Geometrical constructions.

Physical conditions of image formation. Seidel's theory of the five aberrations. Old and new achromats. Computation of lenses.

Apertures and the effects depending upon them.

Optical instruments.

Text books:—

DRUDE—Theory of Optics, Chapters I., II., III., IV. and V.

HEATH—Geometrical Optics, Sections 47 to 51, 67 to 69, 104 to 118, 124 to 155.

LUMMER—Photographic Optics, Chapters I. to IX., Appendices II. and III.

Gravity and Terrestrial Magnetism.

Elementary principles of Dynamics with special reference to the case of oscillations about a fixed axis.

Definitions of velocity, acceleration, mass, density, momentum, moment of inertia, radius of gyration, centre of oscillation, &c.

Units of length, time and mass, and derived units. Dimensions of derived units. Transformation from one system of units to another.

The use of the pendulum to determine the value of gravity. Kater's pendulum; Mendenhall ½ seconds pendulum.

Relations between the value of gravity and the figure of the earth.

Methods of determining the terrestrial magnetic elements.

Magnetometer; the dip circle.

Determination of magnetic intensity with the dip circle (Lloyd's method).

Distribution of terrestrial magnetism on the earth's surface. Lines of equal declination, inclination and intensity. Poles.

Text books:—

NIPHER—Magnetic Measurements.

SCHOTT—Magnetism, Appendix No. 8, U.S.C. & G. Survey, 1881.

Smithsonian Physical Tables.

Meteorology, Geology and Mineralogy.

Meteorology.

Apparatus and methods for the measurement of temperature atmospheric pressure, wind, atmospheric moisture, precipitation, cloud and sunshine.

Thermodynamics of the atmosphere. Isothermal and adiabatic changes. Potential temperature. Temperature gradients.

General motions of the atmosphere. Theory of the general circulation.

Secondary motions of the atmosphere. Cyclones and anti-cyclones.

Applied meteorology. Oscillations in climates. Meteorology applied to agriculture.

Text book:—

WALDO—Modern Meteorology.

Geology and Mineralogy.

Rock-forming minerals. Principles of classification.

Igneous rocks. Aqueous and eolian rocks. Metamorphic rocks.

Stratification and the formation of rock-beds. Concretionary and secretionary structures. Inclination and curvature of strata. Joints, faults or dislocations.

Eruptive rocks. Metamorphism. Ore-formations.

Geological surveying.

Economic aspects of geological structure. Soils and Subsoils. Surface features.

Text book:—

GEIKIE—Structural and Field Geology.

TEXT BOOKS RECOMMENDED

APPENDIX to the manual of surveys.

BALDWIN—On the Measurement of Nine Base Lines, Appendix No. 3, U.S.C. & G. Survey, 1901.

BREED AND HOSMER—The Principles and Practice of Surveying. —2 Vols., *Wiley & Sons.*

BURRARD—Handbook of Professional Instructions for the Trigonometrical Branch, Survey of India Dept., *Government Printing Office, Calcutta,—Henry L. King & Co., 65 Cornhill, London, Eng.*

CHANDLER—Elements of the Infinitesimal Calculus, *Wiley & Sons.*

CHAUVENET—Plane and Spherical Trigonometry, *Lippincott.*

CHAUVENET—Spherical and Practical Astronomy, *Lippincott.*

CHURCH—Descriptive Geometry, *The American Book Co.*

CLOSE AND CLARKE—Map Projections, in article "Map" Vol. XVII., Encyclopedia Brittanica.

CLOSE—Text books of Topographical and Geographical Surveying, *His Majesty's Stationery Office, Wyman & Sons, Ltd., Fetter Lane, London, E.C.*

CRANDALL—Text book on Geodesy and Least Squares, *Wiley & Sons.*

DRUDE—The Theory of Optics, *Longmans, Green & Co.*

GEIKIE—Structural and Field Geology, *D. Van Nostrand & Co*

GORE—Elements of Geodesy, *Wiley & Sons.*

HALL AND KNIGHT—Higher Algebra, *The Macmillan Co.*

HAYFORD—Precise Levelling in the United States, Appendix No. 3. U.S.C. & G. Survey, 1903.

HAYFORD—Triangulation Southward along the 98th Meridian. Appendix No. 4, U.S.C. & G. Survey, 1903.

HAYFORD—A Test of a Transit Micrometer, Appendix No. 8, U.S.C & G. Survey, 1904.

HEATH—Elementary Treatise on Geometrical Optics, 2nd Edition, *Cambridge University Press.*

JOHNSON—Theory and Practice of Surveying, *Wiley & Sons.*

LODGE—Integral Calculus, *George Bell & Sons.*

LUMMER—Photographic Optics, *Macmillan & Co.*

MANUAL of instructions for the survey of Dominion Lands.

MERRIMAN—Precise Surveying and Geodesy, *Wiley & Sons.*

MERRIMAN—Text book on the Method of Least Square, *Wiley & Sons.*

MIDDLETON AND CHADWICK—A Treatise on Surveying, *E. & F. N. Spon.*

NEWCOMB—Compendium of Spherical Astronomy, *The Macmillan Co.*

NIPHER—Theory of Magnetic Measurements, *Van Nostrand.*

SCHOTT—Magnetism, Appendix No. 8, U.S.C. & G. Survey, 1881.

SMITH—Conic Sections, *The Macmillan Co.*

SMITH—Solid Geometry, *The Macmillan Co*

SNOWBALL—Plane and Spheriacl Trigonometry, *The Macmillan Co.*

SMITHSONIAN Physical Tables, *U. S. Smithsonian Institution.*

STANLEY—Surveying and Levelling Instruments, *E. & F. N. Spon.*

TODHUNTER AND LEATHEM—Spherical Trigonometry, *The Macmillan Co.*

WALDO—Modern Meteorology, *Charles Scribner's Sons.*

WILLIAMSON—Differential Calculus, *Longmans, Green & Co.*

WILLIAMSON—Integral Calculus, *Longmans, Green & Co.*

WOODWARD—On the Measurement of the Holton Base Line, Appendix No. 8, U.S.C. & G. Survey, 1892.